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Exploratory Fisheries for Rock Crab, *Cancer irroratus*, and Jonah Crab *Cancer borealis*, in Canadian Lobster Fishing Areas 34, 35, 36 & 38

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Abstract

This document describes the evolution of inshore exploratory rock and Jonah crab fisheries in the Gulf of Maine, in LFA's 34, 35, 36 & 38, since 1995. Trends in landings, effort and catch rates (kg per trap haul) were analyzed to assess the potential impact that the fishery has had on the rock and Jonah crab resources in each LFA.

Commercial concentrations of Jonah crabs have been found off southwestern Nova Scotia in the midshore (LFA 34) and off southern Grand Manan (LFA 38). Commercial concentrations of rock crabs were found in the St. Marys Bay area (LFA 34), in the Annapolis Basin area (LFA 35), and in several areas situated between Passamaquoddy Bay and Point Lepreau, N.B. (LFA 36). In 1995 some rock crabs were found in LFA 38, off Grand Manan. However the search for a viable concentration of rock crab in LFA 38 was abandoned as effort was diverted to the more lucrative Jonah crab fishery.

The mean size of male Jonah crab was greater in LFA 34 (139 to142 mm carapace width, CW) than in LFA 38 (131 to 136 mm CW). The mean sizes of male rock crabs (111 to 122 mm CW) were similar in all areas, though different trap types were used. The annual catch rates for Jonah crab were similar in LFA 34 (4.1 to 6.3 kg/th) and LFA 38 (4.8 to 6.5 kg/th). Rock crab annual catch rates, were higher in LFA 35 (5.6 to 8.1 kg/th) compared to LFA 34 (2.4 to 4.3 kg/th) and LFA 36 (2.3 to 3.1 kg/th). By-catch of lobsters did not seem to be a problem in both crab fisheries.

With the limited information gathered during the last five years, it is premature to predict the sustainability of this fishery. However there is still some room for limited expansion in unexplored areas. Data gathered in this report indicates that the current level of effort is not having any obvious impact on the resource such as a reduction in average catch size or reduction in catch rates. The economic feasibility of this fishery is marginal and very dependant on the value and the demand for the product.

Jonah crabs and rock crabs are also fished as a by-catch in the lobster fishery. The potential effort, which can be exerted by the lobster fishery, is far greater than the current directed fishery. Removals by the lobster fishery are a fundamental piece of missing information needed for the assessment of rock and Jonah crab stocks. The by-catch issue should be reviewed on an LFA by LFA basis since in some LFA's these issues could be more easily resolved than in others.

Résumé

Le présent document décrit l'évolution de la pêche côtière exploratoire du crabe commun et du crabe nordique qui a été effectuée depuis 1995 dans les ZPH 34, 35, 36 et 38 du golfe du Maine. Les tendances en ce qui concerne les débarquements, les efforts et les taux de prise (kg par casier levé [cr]) ont été analysées en vue d'évaluer l'impact potentiel des pêches sur le crabe commun et le crabe nordique dans chaque ZPH.

Des concentrations commerciales de crabes nordiques ont été trouvées dans une zone semi-hauturière au large du Sud-Ouest de la Nouvelle-Écosse (ZPH 34) et au large du sud deGrand Manan (ZPH 38). Des concentrations commerciales de crabe commun ont été trouvées dans la région de la baie Ste-Marie (ZPH 34), dans la région du bassin Annapolis (ZPH 35) et dans plusieurs régions situées entre la baie Passamaquoddy et pointe Lepreau, N.-B. (ZPH 36). En 1995, des crabes communs ont été trouvés dans la ZPH 38, au large de Grand Manan. Cependant, la recherche d'une concentration viable de crabes communs dans la ZPH 38 a été abandonnée, car les efforts se sont concentrés sur la pêche plus lucrative du crabe nordique.

La taille moyenne des crabes nordiques mâles était plus grande dans la ZPH 34 (largeur de carapace [LC] = 139 à 142 mm) que dans la ZPH 38 (LC = 131 à 136 mm). La taille moyenne des crabes communs mâles (LC = 111 à 122 mm) était semblable dans toutes les régions, même si différents types de casiers ont été utilisés. Les taux annuels de prises de crabes nordiques étaient semblables dans la ZPH 34 (4,1 à 6,3 kg/cr) et la ZPH 38 (4,8 à 6,5 kg/cr). Les taux annuels de prises de crabes communs étaient plus élevés dans la ZPH 35 (5,6 à 8,1 kg/cr) que dans les ZPH 34 (2,4 à 4,3 kg/cr) et 36 (2,3 à 3,1 kg/cr). Il semble que la prise accidentelle de homards n'était pas un problème lors de la pêche des deux sortes de crabes.

En raison du peu d'information recueillie les cinq dernières années, il est trop tôt pour prévoir la durabilité de cette pêcherie. Cependant, une expansion limitée dans des régions inexplorées est encore possible. Les données recueillies dans le présent rapport indiquent qu'aucun impact marqué (comme une réduction de la taille moyenne des prises ou une réduction des taux de prise) n'a été observé avec le niveau actuel d'effort de pêche. La faisabilité économique de cette pêcherie est marginale et très dépendante de la valeur ainsi que de la demande du produit.

En outre, des crabes nordiques et des crabes communs sont pêchés accidentellement lors de la pêche du homard. L'effort de pêche potentiel, qui peut être affaibli par la pêche du homard, est beaucoup plus important que la pêche dirigée qui se fait actuellement. Afin d'évaluer les stocks du crabe nordique et du crabe commun, il est essentiel d'avoir de l'information sur les prélèvements provenant de la pêche du homard. Le problème des prises accidentelles doit être examiné dans chacune des ZPH, puisqu'il peut être résolu plus facilement dans certaines zones que dans d'autres.

Introduction

Biological Background

Jonah crab, *Cancer borealis*, and rock crab, *Cancer irroratus*, can be found from Newfoundland to Florida (Haefner 1977; Wenner et al., 1992). Off Nova Scotia and the Bay of Fundy, Jonah crabs are found primarily at depths between 50-300 m, while rock crab is commonly found in shallow water less than 20 m. The habitat, occupied by Jonah crab, varies from rocky substrates in Narragansett Bay (Jeffries 1966) and off the coast of Maine (Krouse 1980), to silt and clay bottom on the continental slope (Musick and McEachran 1972; Wenner et al. 1992). Rock crab prefer sandy bottom. Historically, there is limited biological information available on Jonah crabs in the Gulf of Maine. In Norfolk Canyon, off the mouth of Chesapeake Bay, Virginia, males mature at 90-100 mm carapace width, CW, and female Jonah crabs mature at 85 mm CW (Carpenter 1978; Wenner et al. 1992). Preliminary analysis of Jonah crab maturity on the Scotian Shelf has shown that morphometric maturity (or functional maturity) of 50 % of the males examined occurred at 128 mm CW (Moriyasu, M., et al. in prep). This is larger than the size of physiological maturity (110 mm CW). The estimated size of 50% maturity for female Jonah crab occurred at 92 mm CW (Benhalima, K., et al. 1998). For rock crab in the Gulf of Maine, the size at which 50% of rock crab are physiologically mature occurs at about 49 mm CW for females and 62 mm CW for males (Campbell and Eagles 1983). In the Gulf of Maine, male Jonah crab can reach a maximum carapace width of over 222 mm (Robichaud et al. 2000), whereas male rock crab reach a maximum of only 150 mm CW. Female Jonah crab usually do not exceed 150 mm CW while female rock crab rarely reach 110 mm CW.

Fishery Background

Since the 1960's, Jonah crab and rock crab have been occasionally landed as by-catch in the various lobster fisheries across the Maritimes, as well as in sporadic directed fisheries (Wilder 1966; Scarratt and Lowe 1972; Elner and Robichaud 1984; 1985; Elner 1986). Due to favorable market conditions during the late 1980's and early 1990's several rock or Jonah crab exploratory fisheries were initiated across the Maritimes. In the Gulf of Maine, new exploratory rock and Jonah crab fisheries were initiated in Southwest New Brunswick (Lobster Fishing Areas, LFA's 36 & 38) in 1995 and in Southwest Nova Scotia (LFA's 34 & 35) in 1996 (Fig. 1). Two Developing Species Advisory Boards (DSAB's) were created to provide advice to management, on these exploratory crab fisheries as well as other new commercial species. The two DSAB's evolved independently, with science as the only common link between the two. Crab permits were distributed to fishermen from a number of ports to ensure exploratory fishing occurred over a wide geographical range. Permits were valid only within the particular LFA where issued. With the creation of a Regional Developing Species Advisory Board (RDSAB) in 1998 there was a concerted effort to implement uniform regulations throughout all LFA's.

This document describes the evolution of these exploratory inshore rock and Jonah crab fisheries within each LFA and DSAB management regime. After 5 years in operation, these directed rock and Jonah crab fisheries remain at a Stage II of development, i.e., the exploratory phase. The impact that these fisheries have had on the resource is evaluated. Trends in landings, effort and catch rates (kg per trap haul), as well as size structure of both crab species were examined to assess the potential impact of the fishery on the crab resource in each individual LFA. Prospects for further development of these fisheries, and science issues, which remain to be addressed, are discussed.

Evolution of the Rock/Jonah Crab Exploratory Fishery (1995-1999)

The 1995 Crab Fishing Season: Two exploratory rock /Jonah crab permits were issued in LFA 38 and five permits were issued in LFA 36. The southwestern New Brunswick DSAB was created and regulations for this new crab fishery were introduced. Each fisher had a 100 trap limit, and only conical crab traps were permitted. Each conical trap was required to have a minimum of two circular openings of 63.5 mm (2 ½") in diameter. There was no minimum size limit, and lobsters were not allowed to be retained. The fishing season was open all year.

The 1996 Crab Fishing Season: Seven exploratory rock /Jonah crab permits for LFA 36 & 38 were reissued to the same permit holders as in the previous year. A new trap limit was set at 200, and minimum size limits of 121 mm CW for Jonah crab, and 102 mm CW for rock crab were introduced. Also introduced was a minimum 20 fishing trip requirement in order for participants to retain their exploratory fishing permits. Fishers were also required to fully participate in an approved Dockside Monitoring Program.

Nine exploratory rock /Jonah crab permits were issued in LFA 34, and five permits were issued in LFA 35. A southwestern Nova Scotia DSAB was created and several distinct regulations were introduced to accommodate these new fisheries. In LFA 34, an inshore zone (zero to 20 Km or 0-12 miles) and midshore zone (20 to 80 Km or 12 to 50 miles) were created. Seven permits were allocated to the inshore and two to the midshore. In LFA's 34 & 35, the minimum size limit for Jonah crab was set at 130 mm, and 102 mm CW for rock crab. The trap limit was restricted to 100, and modified lobster traps were permitted to be used as well as conical crab traps. The crab fishing season was set to open one week after the close of the spring lobster fishing season, which is the 31st of May in LFA 34 and the 31st of July in LFA 35. The crab season then closes one week before the opening of the fall lobster season which begins the last Monday in November in LFA 34 and the 15th of October in LFA 35.

The 1997 Crab Fishing Season: In LFA's 36 & 38, seven exploratory rock /Jonah crab permits were reissued to the original permit holders. The minimum 20 fishing trip requirement was reduced to 15. In LFA 35, four exploratory rock crab permits were issued. In LFA 34 the inshore \ midshore boundary was removed. Eight Jonah crab and two rock crab permits were issued. In LFA's 34 & 35, the permit

holders were given until the end of June 1999 to decide which crab species (rock or Jonah) they were going to target. The trap limit was increased to 150.

The 1998 Crab Fishing Season: In LFA 38, a total of five rock/Jonah crab permits were issued. Three new crab permits were issued and a fourth permit was given as a replacement of an inactive participant from the previous year. In LFA 36, eight rock/Jonah crab permits were issued. Three new exploratory rock/Jonah crab permits were issued and a fourth permit was given as a replacement of an inactive participant from the previous year.

In LFA's 34 & 35, exploratory Jonah crab permits were separated from rock crab permits, and each species of crab was given individual license conditions. In LFA 35, the five crab permits were reissued as rock crab only permits. In LFA 34, five Jonah crab permits and 2 rock crab permits were issued. In both LFA's the permit holders had until June 1999 to make a formal request to change the species of crab assigned on their crab permits. The maximum trap limit for Jonah crab was set at 375, and for rock crab the limit remained at 150 traps. When directing for Jonah crab all traps were to include a minimum of two escape gaps of a minimum diameter of 79 mm (3.125 inches). When directing for rock crab a minimum of two escape gaps of a minimum diameter of 63.5 mm (2.5 inches) were required. When using modified lobster traps and directing for rock or Jonah crab, the trap entrance was required to be rectangular with the opening no more than 76 mm (3 inches) in height with no limit on the length. Permit holders were required to land a minimum of 20000 lbs of Jonah (in LFA 34) and 10000 lbs of rock crab (in LFA's 34 & 35) to be eligible for a 1999 inshore exploratory rock or Jonah crab permit.

The 1999 Crab Fishing Season: In LFA's 36 & 38, eight and five rock/Jonah crab permits were reissued, respectively. In LFA 38, the trap limit was increased to 300, while in LFA 36 the limit remained at 200 traps. Only conical traps were allowed, and were required to have a minimum of two circular escape openings of 63.5 mm (2 ½") in diameter. The minimum size limit remained at 121 mm CW for Jonah crab and 102 mm CW for rock crab. For both species only males could be retained. Basic participation required 15 fishing trips with landings that were 30% of the average landings. The fishing season remained open from January 1st to December 31st.

In LFA 35, five rock crab permits were issued and in LFA 34, 2 rock crab and 5 Jonah crab permits were issued. Regulations remained the same as in 1998, except that the width of the entrance was reduced from 76 mm (3 inches) to 48 mm (1 7/8 inches). Modified lobster traps were permitted with the same trap limit as in 1998. The season was only open during the closed lobster season as in previous years.

Assessment Methodology

Biological Inputs

At-sea sampling provided detailed information on crab size structure in the traps (including sub-legal, female, berried, and soft-shell crabs). All crabs retained in individual trap hauls were measured (CW in mm), and examined to determine species, sex, molt condition and egg development stage for berried crabs. For each trap haul on a given day of sampling, the location, depth, and trap type were recorded. As the exploratory rock/Jonah crab fisheries were evolving in the various LFA's, emphasis was placed in sampling a series of representative ports in areas and at time periods when high fishing activity occurred.

Landings and Effort Analysis

Logbook data is a useful source of information for monitoring fishing activity. All participants in the exploratory rock and Jonah crab fisheries were required to complete daily logbooks. The information requested was the number of traps hauled, soak days, number of pounds landed, the species of crab fished, depth, date, location, and the type of trap fished. Logbook information, landing and effort data were used to evaluate trends in catch rates by time periods (weekly or monthly intervals) for the various fishing locations. Fishery information was also used to determine distribution of effort.

Results

Effort Distribution

Jonah crab: Since 1995, the exploratory Jonah crab fishery has located two commercial concentrations of Jonah crabs (Fig. 2). One is located off southwestern Nova Scotia in the midshore in LFA 34. The second is located off southern Grand Manan in LFA 38. Jonah crabs were found in commercial concentrations only in waters deeper than 75 m. Although some Jonah crabs were found off Campobello Island (LFA 36) and in St Marys Bay (LFA 34) no commercial concentration has yet been established.

Rock Crab: Since 1995, the exploratory rock crab fishery located several commercial concentrations (Fig. 3). Commercial concentrations of rock crabs were found in the St. Marys Bay area (LFA 34), in the Annapolis Basin area (LFA 35) and in several areas situated between Passamaquoddy Bay, and Point Lepreau, N.B (LFA 36). In 1995, some rock crabs were found off Grand Manan in LFA 38. However the search for a viable concentration of rock crab in LFA 38 was abandoned as effort was diverted to the more lucrative Jonah crab fishery.

Catch Size Structure

At-sea sampling was conducted on an opportunistic basis with emphasis on developing a time series when possible. All sampling occurred between July and September, when most of the fishing occurred. In some instances, several samples taken during the same month in the same location were combined into one composite sample.

Jonah Crab: At-sea sampling in the midshore area of LFA 34, in 1998 (August and October) and 1999 (August only) indicated mean body sizes of 139-142 mm CW for males, and 121-125 mm CW for females (Fig. 4). Less than one percent of the females captured in the traps were berried.

Since 1995, in LFA 38, monthly summer sampling of Jonah crab indicated that the mean size for males ranged between 131-136 mm CW (Fig. 5). The lower mean size of 127 mm CW observed in July 1995 is considered biased because the sample was taken at the outset of this exploratory crab fishery. The mean size of females remained stable, between 111 and 116 mm CW. Over the five years of sampling the proportion of females that were berried never exceeded 5%.

A possible reason for the larger mean size of crabs in LFA 34 compared to LFA 38, is that the minimum size limit in LFA 34 is 130 mm CW compared to 121 mm CW for LFA 38. Regulation in gear design (minimum diameter size of escape vents) was set to reflect the retention rate proportional to the size of crab targeted. The minimum diameter of the escape gaps in LFA 34 was 79 mm (3.125 inches) compared to 63.5 mm (2.5 inches) in LFA 38. In LFA 34, the percentage of crabs below the legal size limit of 130 mm CW varied between 9 and 19%, compared to 16-24 % that were below the minimum size limit of 121 mm CW in LFA 38.

Rock Crab: In LFA 34 (St. Marys Bay) and LFA 35 (Annapolis Basin), rock crab at-sea samples were obtained during September 1996 and August 1999 (Fig. 6). The average size for males was larger in St. Marys Bay (121 and 118 mm CW) compared to Annapolis Basin (111 and 113 mm CW). The percentage of male crab below the legal size limit of 102 mm CW was lower in St. Marys Bay (5 and 8 %) compared to Annapolis Basin (14 and 20 %). The mean size of females was higher in St. Marys Bay (93 mm CW) compared to Annapolis Basin (89 and 90 mm CW) (Fig. 6). The percentage of berried females was under 1 % in both areas.

In LFA 36, the area between Beaver Harbor and Maces Bay was sampled in July 1995 and August 1999, and Passamaquoddy Bay was sampled for the first time in September 1999 (Fig. 7). The mean size of males was greater in Passamaquoddy Bay (122 mm CW) compared to the samples obtained along the New Brunswick shore (113 and 118 mm CW). The percentage of males crab below the minimum legal size of 102 mm CW was lower in Passamaquoddy Bay (0.3%) compared to the samples taken along the New Brunswick coast (5 to 7 %). The mean size of female crab was also greater in Passamaquoddy Bay (103 mm CW) compared to the Maces Bay area (86 and 95 mm CW). The percentage of females that were

berried averaged 2%. In LFA 38, one rock crab sample was taken during August 1995 (Fig. 7) before fishing effort was diverted to Jonah crab fishing. The mean size of males was 113 mm CW and 83 mm CW for females.

Fisheries Landings Information

Landings and catch rate information are not complete. The amounts are based on the number of logbooks received and tabulated by us and does not necessarily represent the total landings.

Jonah crabs: Jonah crabs were found in commercial concentration in only two areas: the midshore area of LFA 34 and off southern Grand Manan in LFA 38 (Figs. 1 & 2). In both LFA's, most of the fishing took place between June and the end of October, even though the crab season was open all year in LFA 38 (Figs. 8 & 9).

In LFA 34, approximately five crab fishers have been fishing for Jonah crab since 1996. Jonah crab landings peaked in 1997 at 145.8 t (Table 1). However the 1999 landings of 119 t are not complete due to missing logbooks. From 1996 to 1998 the annual catch rate varied between 4.0 and 4.8 kg/th. However, during the 1999 season the annual catch rate increased to 6.3 kg/th. There was no prevailing trend in weekly catch rates throughout each fishing season and the variability in weekly catch rates within each season ranged from lows of between 1.8 to 5.7 to highs of between 7.3 to 7.9 kg/th (Fig. 8).

In LFA 38, between 1995 and 1997 only one Jonah crab fisher was active (Table 1). In 1998, five logbooks were received and in 1999 only four were received. Landings remained between 20.7 and 26.9 t until 1997. During 1998 landings increased to 60.9 t, and preliminary landings in 1999 were 51 t. Since 1995, the annual catch rates ranged between 4.8 and 6.5 kg/th (Table 1). There was no prevailing trend in weekly catch rates throughout each fishing season and the variability in weekly catch rates within each season ranged from lows of between 2.2 to 5 to highs of between 7.1 to 10.9 kg/th (Fig. 9).

Jonah crab catch rates were similar in LFA's 34 and 38 despite the fact that different trap types were used (Table 1; Figs. 8 and 9). Low concentrations of Jonah crabs were also found in LFA 35 (Annapolis Basin) (0.05 to 0.09 kg/th) and in LFA 36, off Campobello Island (0.03 to 0.7 kg/th) (Table 1).

Rock crabs: Rock crabs were found in commercial concentrations in St. Marys Bay (LFA 34), in Annapolis Basin (LFA 35), and in southwestern New Brunswick (LFA 36) (Figs. 1 & 3). Most of the fishing took place between June and October (Figs. 10 & 11). The number of logbooks received varied from year to year (Table 1).

In St. Marys Bay, rock crab landings varied between 36.7 t during 1996 (the first year of fishing) and 5 t in 1998 (Table 1). In 1999, preliminary rock crab landings

indicate an increase to 16.1 t. Annual catch rates varied between 2.4 and 4.3 kg/th with the exception of 1998 when the annual catch rate was down to 1.7 kg/th (Table 1). During the first year of fishing in 1996, weekly catch rates from June to the first week of September, varied between 3.2 and 4.8 kg/th and increased to between 5.9 and 10.4 kg/th during October (Fig. 10). During 1997, the weekly catch rates remained between 1.5 and 3.2 throughout the whole season. During 1998 weekly catch rates were the lowest and varied between 1 and 2.7 kg/th. During 1999, there was an increased in weekly catch rates which varied between 1.2 and 5.2 kg/th. There was no apparent seasonal trend in weekly catch rates throughout the four fishing seasons (Fig. 10).

In Annapolis Basin (LFA 35), rock crab landings peaked at 45.5 t in 1997. Preliminary landings for 1999, at the time of writing, were 13.6 t (Table 1). The annual catch rate in Annapolis Basin (5.6 to 8.1 kg/th) was greater than that of St. Marys Bay (1.7 to 3 kg/th). Each year, the weekly catch rates had a tendency to decline as the season progressed (Fig. 11). Weekly catch rates were the highest during 1996 (3.6 to 10.4 kg/th) and lowest in 1998 (2.9 to 8.3 kg/th).

In LFA 36, landings peaked at 37.1 t in 1998 when new permits were issued. Preliminary landings for 1999 at the time of writing were 24.3 t (Table 1). The annual catch rate varied little between years (2.3 to 3.5 kg/th), even with the increased effort during 1998 and 1999. The annual catch rates in LFA 36 was much lower than those in Annapolis Basin (5.6 to 8.1 kg/th) and similar to those in St. Marys Bay (2.4 and 4.3 kg/th) (Table 1). In LFA 36, there was no prevailing trend in weekly catch rates during the 1995-99 fishing seasons (Fig 12). Within each season the variability in weekly catch rates was relatively low (0.8 and 3.7 kg/th) with the exception of the 1997 season when low effort may have cause increased variability in weekly catch rates (2.1 to 9.1 kg/th) (Fig. 12).

Lobster By-catch

Lobster by-catch has been a management concern since the inception of the exploratory crab fishery. Based on logbook and sea sampling information, lobster by-catch has been negligible in the Jonah crab fishery, which is located in deep water (>75 m), in the midshore area of LFA 34, and off southern Grand Manan in LFA 38.

Based on logbook information, lobster by-catch was more of a problem in the rock crab fishery, which takes place close to shore in shallow warm water during summer. In St Marys Bay (LFA 34), lobster by-catch was higher in the first few years of the rock crab fishery (1996-1997) (Fig. 13). However, in 1998 and 1999 the number of lobsters reported in the logbooks (Fig. 13) and the sea samples (0.22 lob. /th in September 1996 (18 th) compared to 0.10 lob. / th in August 1999 (29 th)) has decreased. In LFA's 35 and 36 the monthly average number of lobsters per trap haul, reported in logbooks, has been lower than 0.3 and has decreased further in 1998 and 1999. Sea sampling information from the Annapolis Basin (LFA 35) shows a similar trend (2.0 lob. /th in September 1996 (6 th)

compared to 0.4 lob. / th in August 1999 (16 th)). Based on sea sampling data from LFA 36 there was no lobsters caught in 100 th in July 1995 and only 0.08 lob. /th out of 68 th during September 1999. Restrictions on the type of traps used and limitations on the size and shape of the entrances seem to have reduced the incidence of lobster by-catch (Fig. 13).

Discussion

This assessment is based on logbook reports that we received and does not necessarily represent all the landings. Our sea sampling of the size structure of the catch is limited to the summer months and to only a few main fishing areas. With the limited information gathered during the last five years, it is not possible to fully evaluate the potential sustainable level of fishing effort in these exploratory crab fisheries.

Jonah crab

The data gathered in this report, indicates that the current level of effort is not having any obvious impact on the Jonah crab resource. There was no evidence of a reduction in average catch size, or reduction in catch rates. Based on the distribution of effort, especially in LFA 34, there may still be room for limited expansion in unexplored areas.

Jonah crabs are fished by a directed fishery, and as a by-catch in the lobster fishery. The information on Jonah crab by-catch, in the lobster fishery, is based on voluntary reporting of Jonah crab by-catch in lobster logbooks and likely underestimated. However, this information indicates that the potential effort by the lobster fishery is far greater than the current directed fishery (Table 1). Removals by the lobster fishery are a fundamental piece of information needed for the assessment of Jonah crab stocks. Until the quantity of Jonah crab removals by the lobster fishery is evaluated and controlled, biological sustainability of the directed fishery cannot be evaluated. The by-catch issues should be reviewed on an LFA by LFA basis since in some LFA's these issues could be more easily resolved than in others. Lobster fishermen should be encouraged to report their by-catch whether it is used directly as bait or sold.

Rock Crab

There is still some room for limited expansion of rock crab fishing effort in unexplored areas in LFA 34, and especially in LFA 38 where rock crab were initially found in 1995, but ignored as effort was directed at the more lucrative Jonah crab. In LFA 35 & 36 it is unlikely that commercial concentrations of rock crab will be located in the upper part of the Bay of Fundy. There is still some possibility for moderate expansion around the Fundy Isles in LFA 36. The current level of effort does not appear to be having any obvious impact on the resource, such as a reduction in average catch size, or reduction in catch rates. Risks of

overfishing of rock crab by the directed fishery are low given current effort levels and the high protection for broodstock provided by minimum size regulation.

Total removals of rock crab in the Gulf of Maine are not known because the by-catch of rock crab by the lobster fishery is not well documented. Anecdotal evidence indicates few rock crab are retained by lobster fishers in some areas (e.g. LFA 38), but in other areas lobster traps are set specifically for rock crab to be used as bait or sold (Table 1). Reported landings in LFA's 34 and 35 have shown that by-catch of rock crabs surpassed landings from the directed fishery in 1999, and could increase or decrease in response to economic factors.

The data in this report shows that the current level of effort is not having an impact on the resource. Due to the low commercial value of rock crab this fishery is marginally viable.

Unresolved Issues

As far as the directed fishery is concerned, management provisions should remain flexible to reflect the developing nature of the fishery. More work needs to be done on evaluating trap designs that limit lobster by-catch in the rock crab fishery before more stringent trap specifications are added to the regulations.

To better evaluate the potential for a rock crab directed fishery, more fishing effort (e.g. increased participation rates, additional permits or additional traps) should be targeted to lightly fished areas.

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Table 1. Annual landings, effort and annual catch rates (based on total landings (kg) divided by total effort (th)) were obtained from rock and Jonah crab fisheries logbooks from LFA's 34, 35, 36 & 38, from 1995-1999. The statistics are based on logbook reports that we received and does not necessarily represent all the landings. The information on crab by-catch in the lobster fishery, is based on voluntary reporting of Jonah crab by-catch in lobster logbooks which are likely underestimated.

Jonah crab		**1995**	**1996**	**1997**	**1998**	**1999****
LFA 34	Trap Hauls		4079	36598	13035	18966
(Midshore)	Landings (t)		19.4	145.8	54.1	119.0
	Mean cpue (kg/th)		4.8	4.0	4.1	6.3
	No. of Logbooks		2	8	6	5
	By-catch (t)	*	*	*	289	152
LFA 35	Trap Hauls		3010	4165	2550	
	Landings (t)		0.2	0.2	0.2	
	Mean cpue (kg/th)		0.07	0.05	0.09	
	No. of Logbooks		3	4	2	
	By-catch (t)		*	*	0	
LFA 36	Trap Hauls	1359			3422	3210
	Landings (t)	0.04			1.8	2.3
	Mean cpue (kg/th)	0.03			0.5	0.7
	No. of Logbooks	4			6	5
	By-catch (t)	*			0	0
LFA 38	Trap Hauls	3875	3875	5125	12760	8939
	Landings (t)	20.7	25.3	26.9	60.9	51.0
	Mean cpue (kg/th)	5.3	6.5	5.3	4.8	5.7
	No. of Logbooks	1	1	1	5	4
	By-catch (t)	*	*	*	27	86

Rock Crab		**1995**	**1996**	**1997**	**1998**	**1999****
LFA 34	Trap Hauls		8558	13916	3000	5451
(St. Marys	Landings (t)		36.7	33.5	5.0	16.1
Bay)	Mean cpue (kg/th)		4.3	2.4	1.7	3.0
	No. of Logbooks		2	2	2	2
	By-catch (t)		*	*	48	33
LFA 35	Trap Hauls		2618	6445	4235	1685
(Annapolis	Landings (t)		19.1	45.5	23.7	13.6
Basin)	Mean cpue (kg/th)		7.3	7.1	5.6	8.1
	No. of Logbooks		3	4	2	2
	By-catch (t)		*	*	13	26
LFA 36	Trap Hauls	7383	6103	2608	14696	10748
	Landings (t)	22.8	16.3	9.1	37.1	24.3
	Mean cpue (kg/th)	3.1	2.7	3.5	2.5	2.3
	No. of Logbooks	4	4	2	6	5
	By-catch (t)	*	*	*	0	23
LFA 38	Trap Hauls	2023				
	Landings (t)	1.9				
	Mean cpue (kg/th)	1.0				
	No. of Logbooks	1				
	By-catch (t)	*	*	*	0.9	5.7

*** Unknown**
**** Preliminary**

Figure 1. Map showing the location of LFA's in the Bay of Fundy and Southwest Nova Scotia.

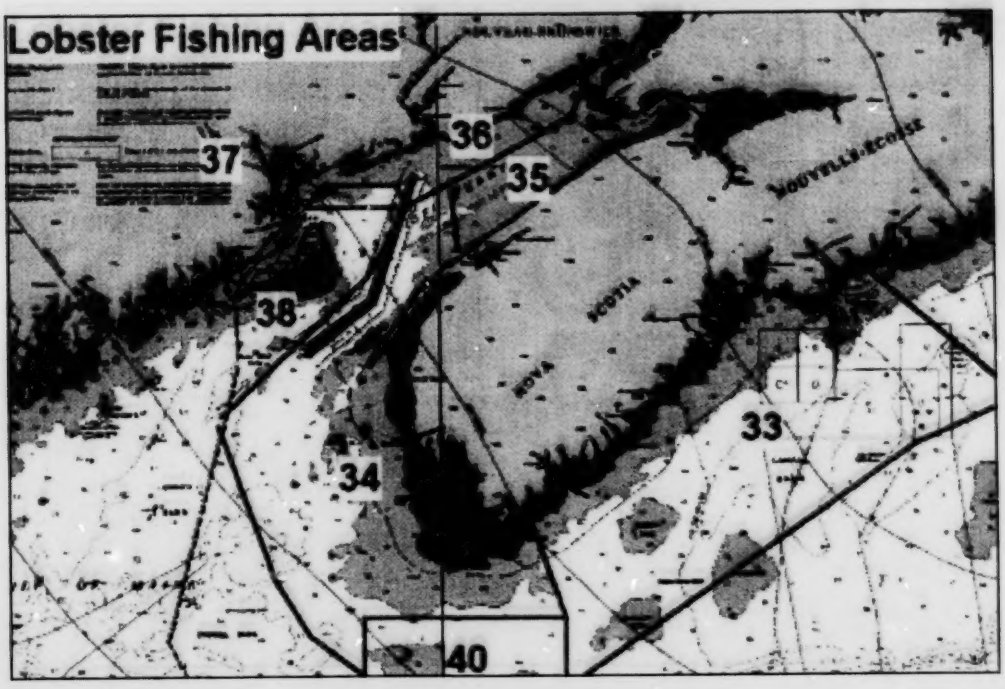
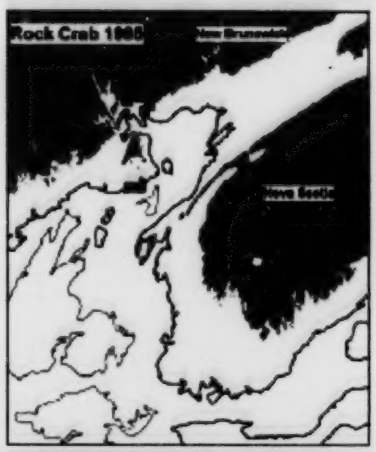
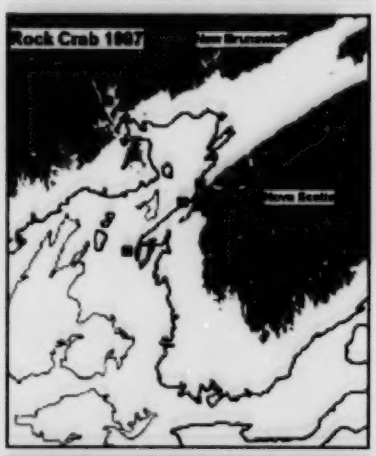


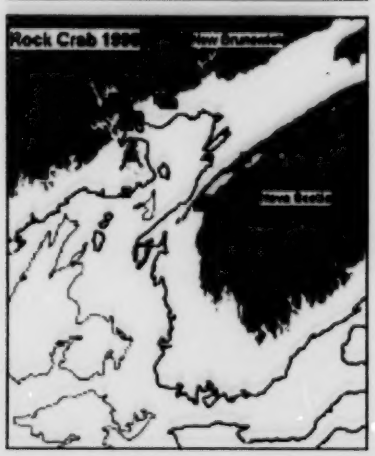
Figure 2. Maps showing the distribution of fishing effort for Jonah crab between 1995 and 1999, as recorded by fishing locations in logbooks (There is no scaling of effort applied at each location. Minimum effort equal one trap haul).

Figure 3. Maps showing the distribution of fishing effort for rock crab between 1995 and 1999, as

recorded by fishing locations in logbooks (There is no scalling of effort applied at each location. Minimum effort equal one trap haul).







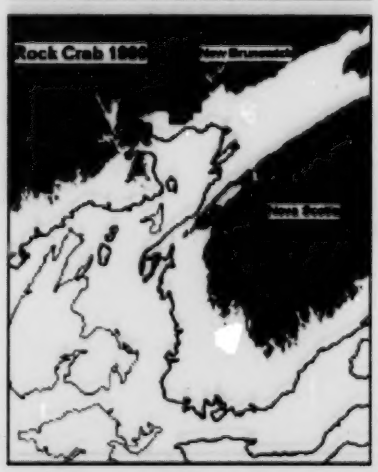


Figure 4. Jonah crab size frequency histograms from at-sea sampling in LFA 34, (midshore) during the 1998 and 1999 crab fishing seasons. Males are in dark histograms and females in light histograms. Berried females are included in data for females. Undersize males in the at-sea trap samples are expressed as a percent of males less than130 mm CW.

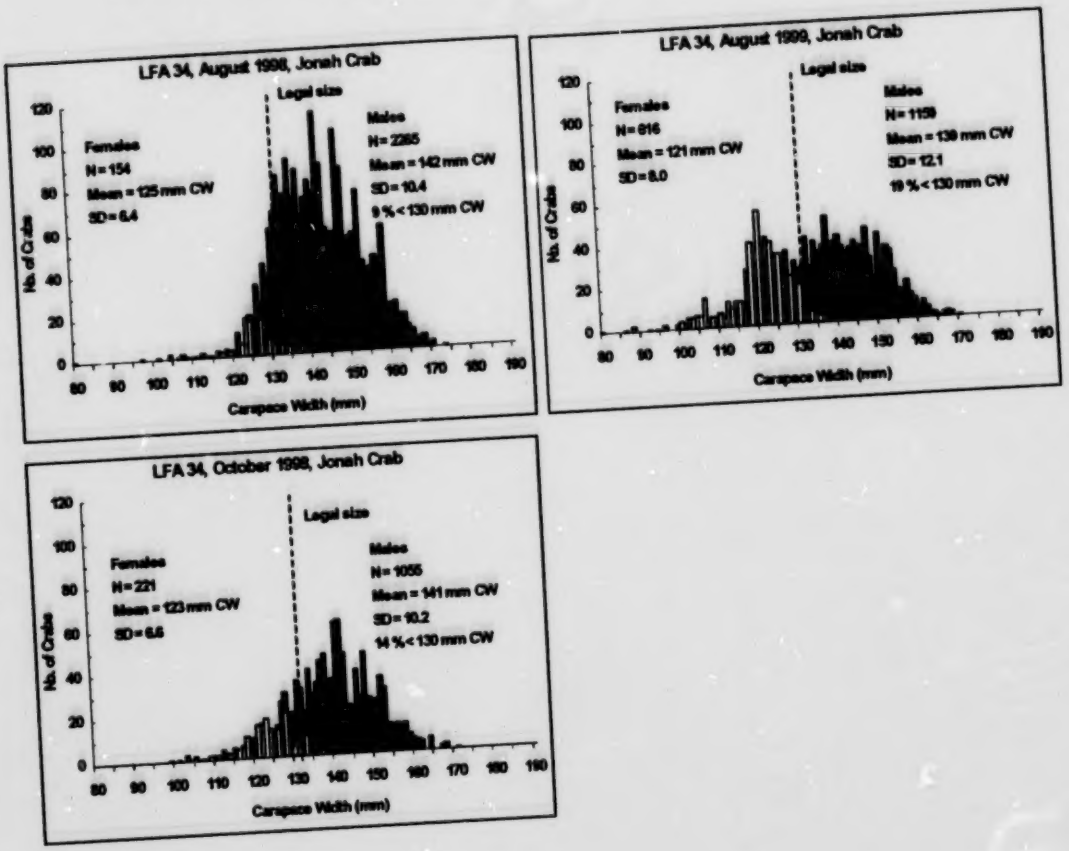


Figure 5. Jonah crab size frequency histograms from at-sea sampling in LFA 38, during the 1995 -1999 crab fishing seasons. Males are in dark histograms and females in light histograms. Berried females are included in data for females. Undersize males in the at-sea trap samples are expressed as a percent of males less than 121 and 130 mm CW.

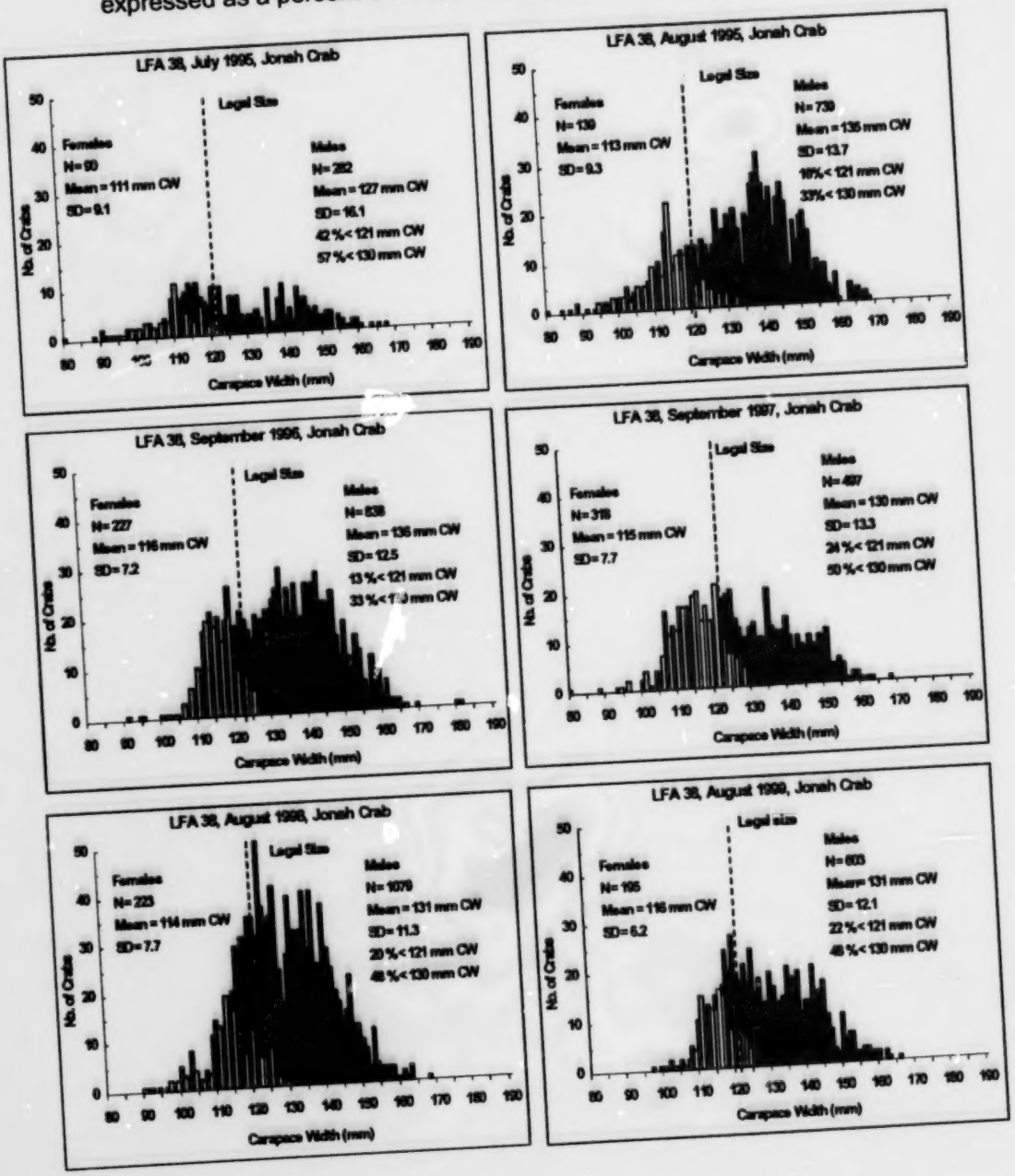


Figure 6. Rock crab size frequency histograms from at-sea sampling in LFA 34 & 35 during the 1996 and 1999 crab fishing seasons. Males are in dark histograms and females in light histograms. Berried females are included in data for females. Undersize males in the at-sea trap samples are expressed as a percent of males less than 102 mm CW.

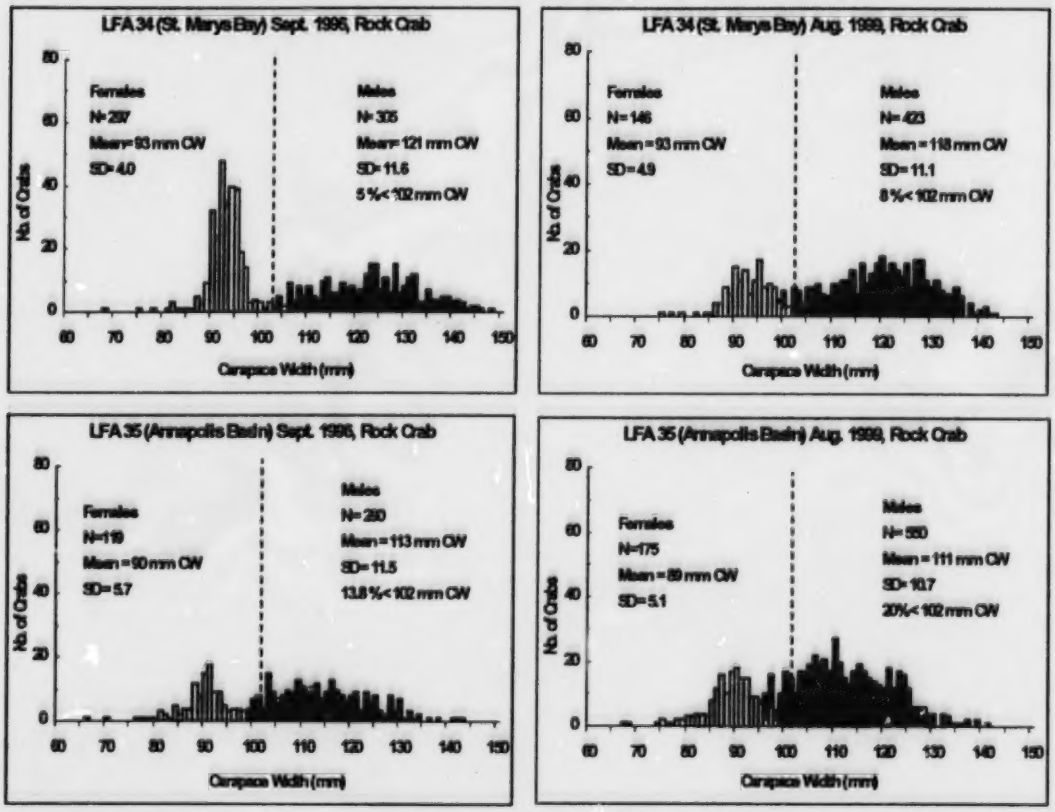


Figure 7. Rock crab size frequency histograms from at-sea sampling in LFA's 36 and 38, during the 1995 and 1999 crab fishing seasons. Males are in dark histograms and females in light histograms. Berried females are included in data for females. Undersize males in the at-sea trap samples are expressed as a percent of males less than 102 mm CW.

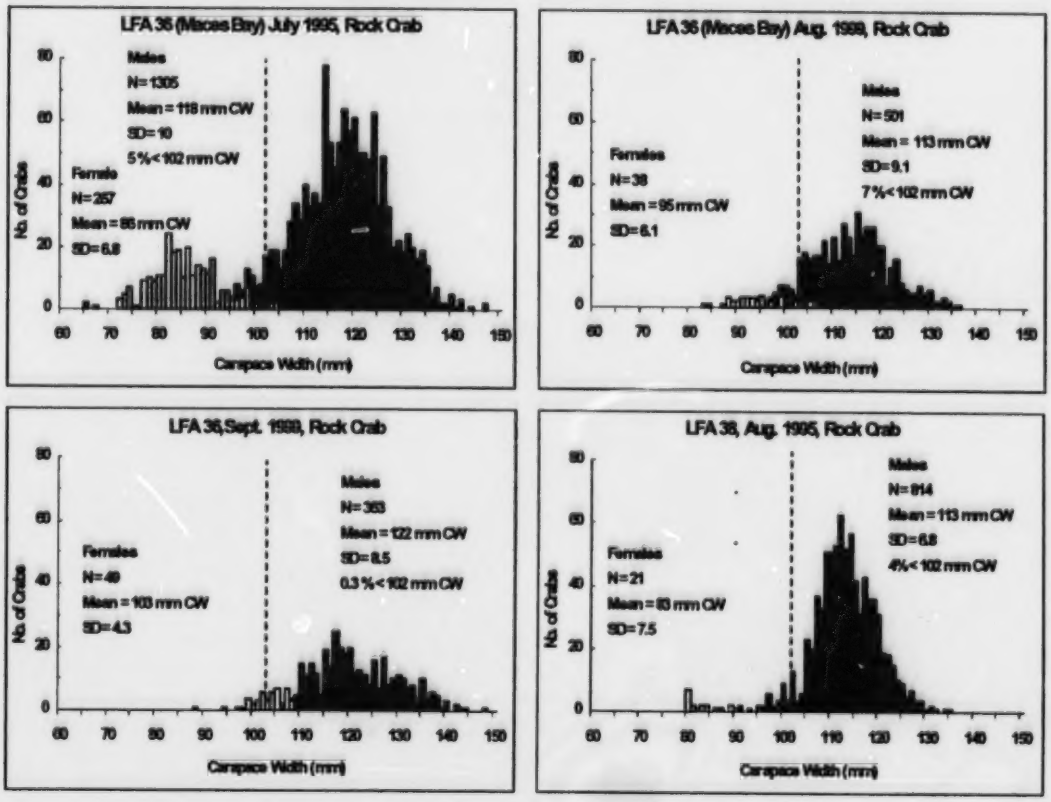


Figure 8. Jonah crab weekly effort in trap hauls and CPUE (kg/th) from LFA 34, midshore logbook data for the 1996 to 1999 crab fishing seasons.

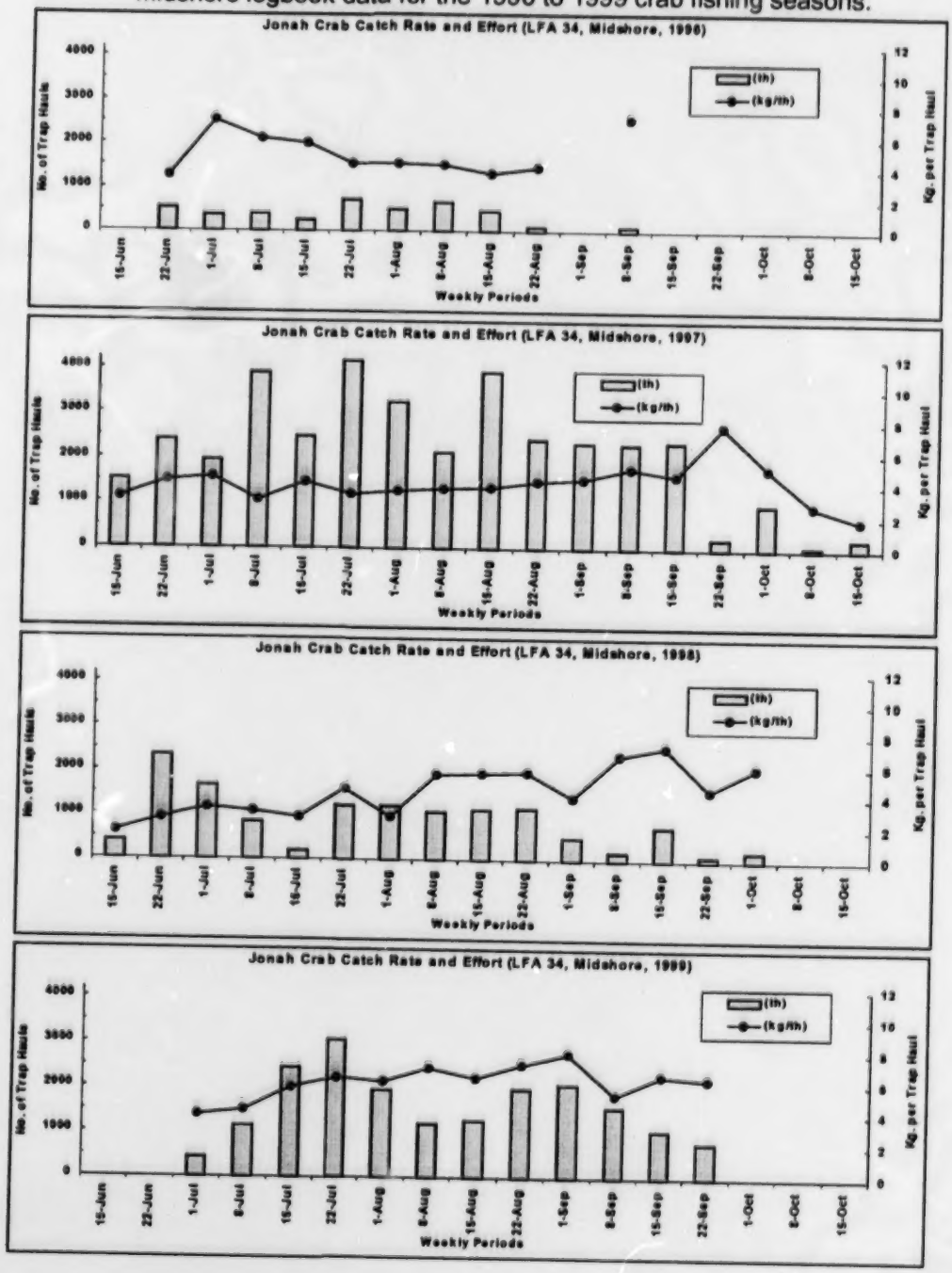


Figure 9. Jonah crab weekly effort in trap hauls and CPUE (kg/th) from LFA 38 logbook data for the 1995 to 1999 crab fishing seasons.

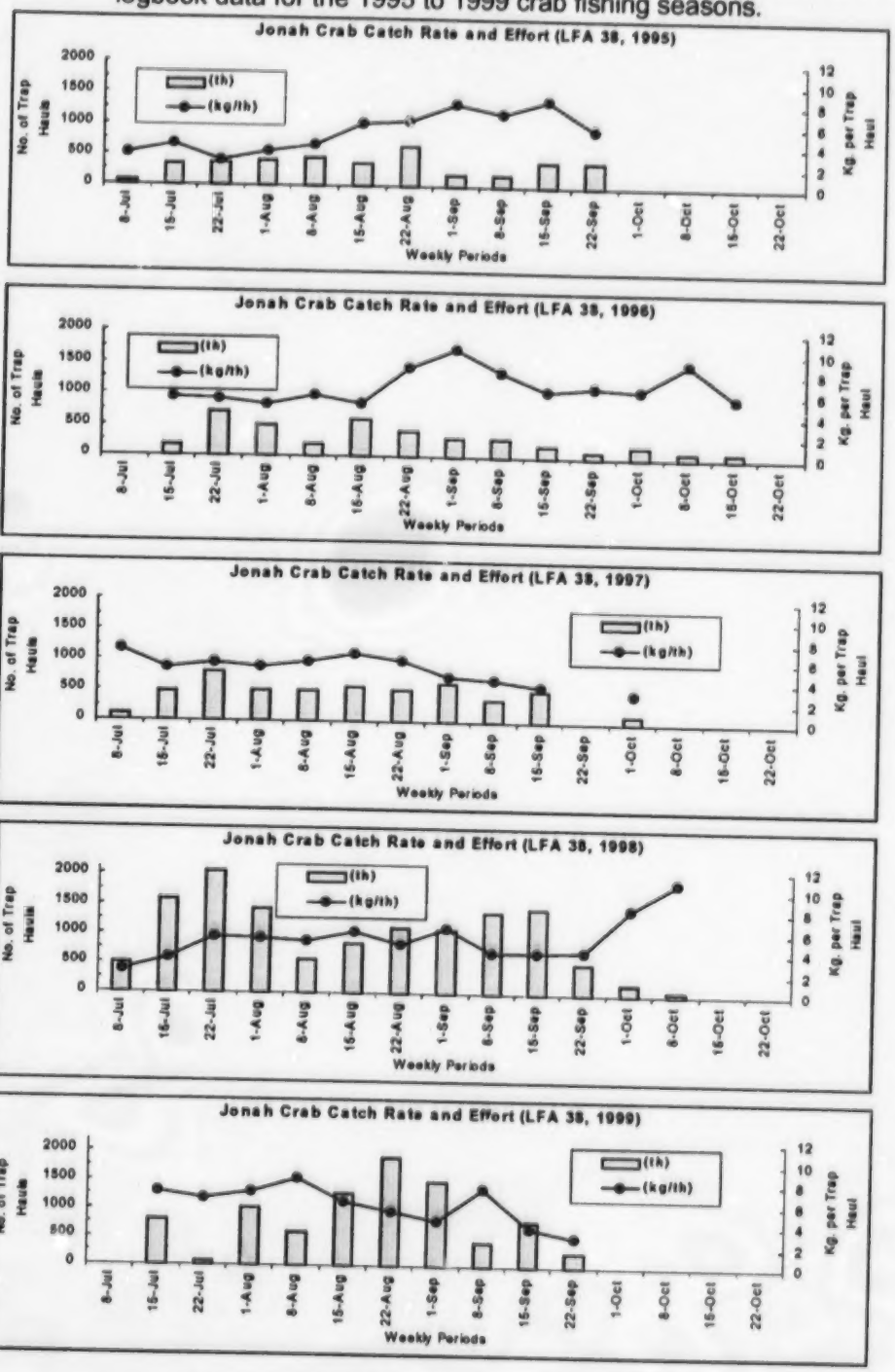
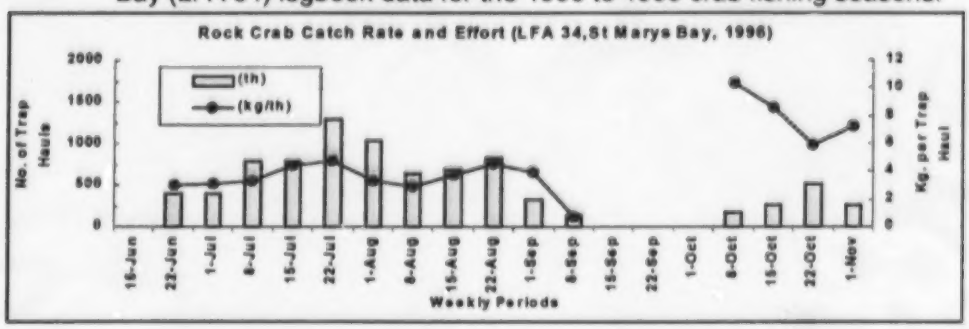
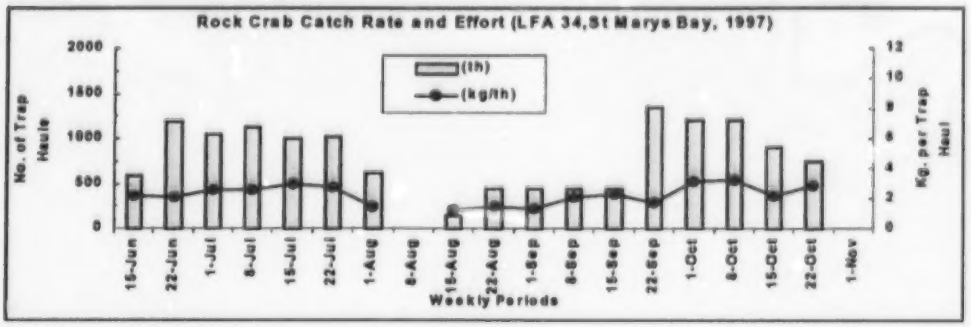
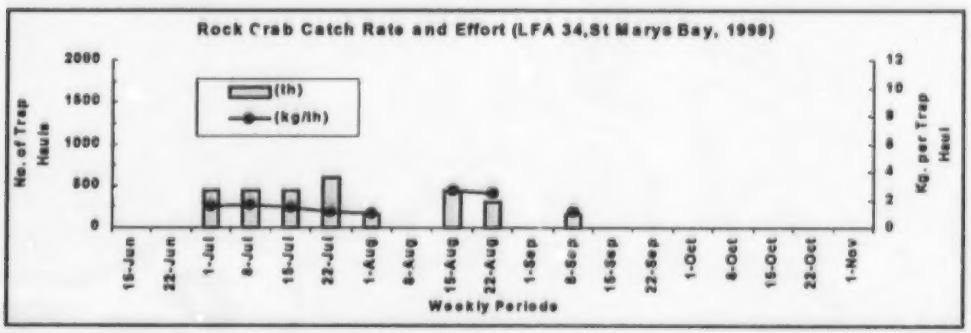


Figure 10. Rock crab weekly effort in trap hauls and CPUE (kg/th) from St Marys Bay (LFA 34) logbook data for the 1996 to 1999 crab fishing seasons.







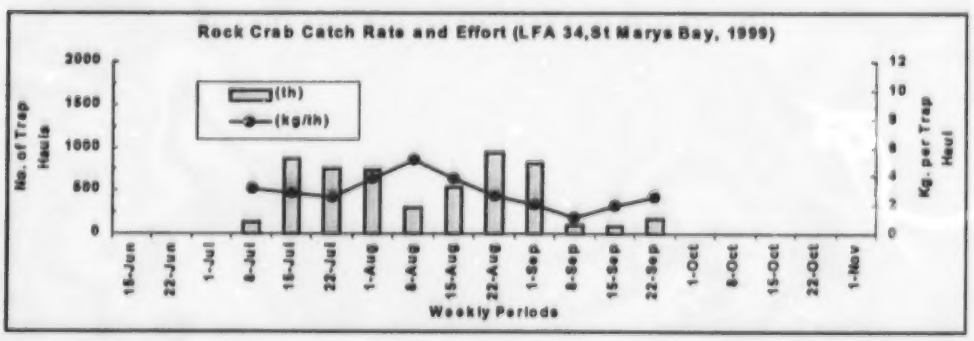
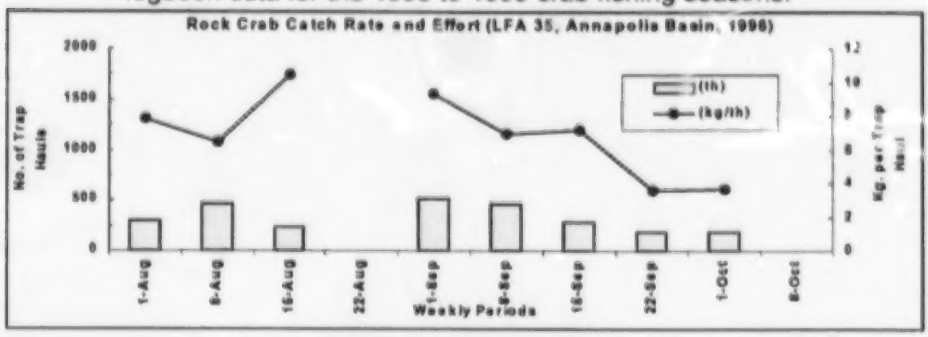
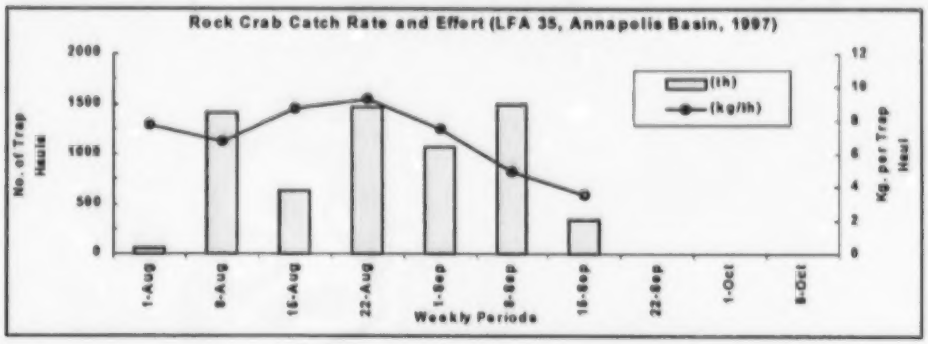
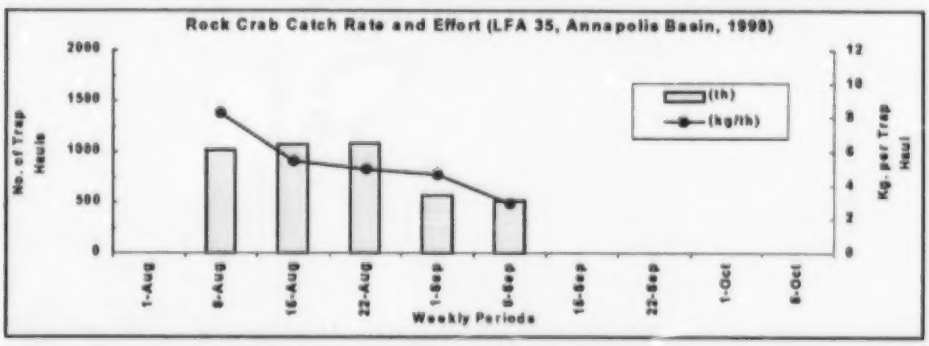


Figure 11. Rock crab weekly effort in trap hauls and CPUE (kg/th) from LFA 35 logbook data for the 1996 to 1999 crab fishing seasons.







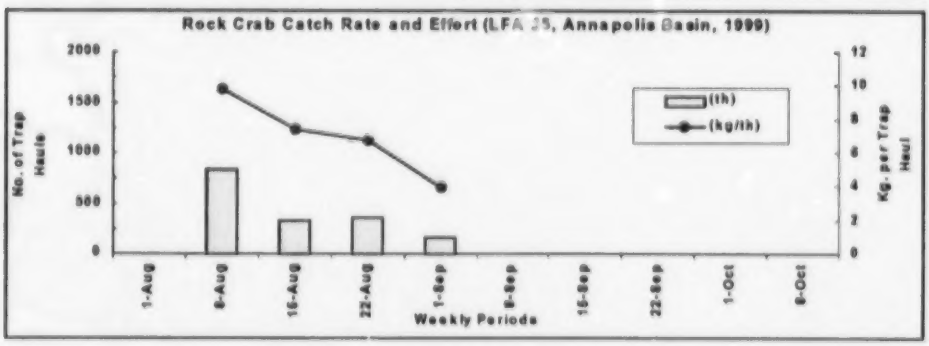
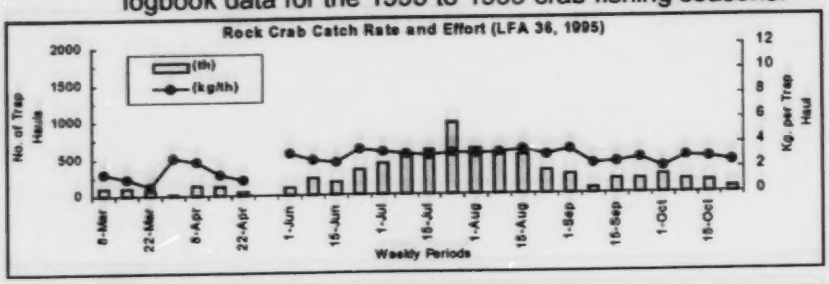
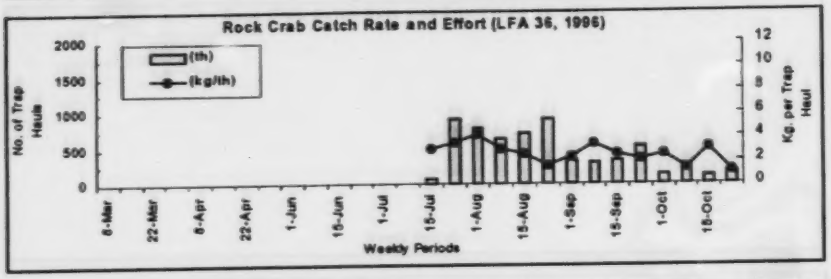
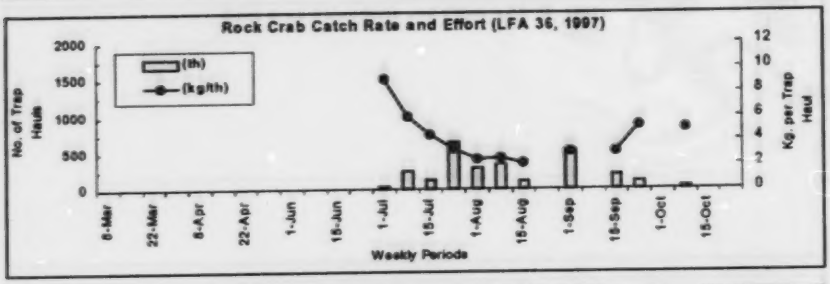
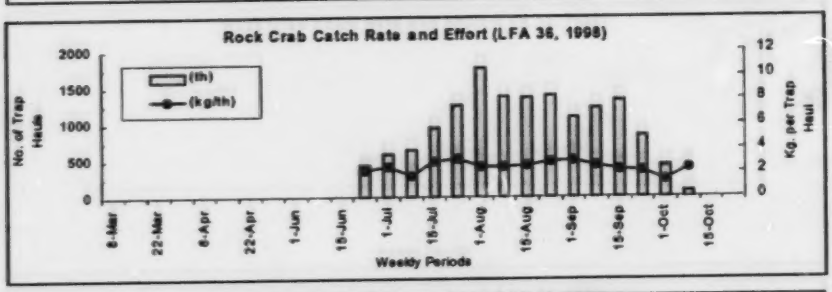


Figure 12. Rock crab weekly effort in trap hauls and CPUE (kg/th) from LFA 36 logbook data for the 1995 to 1999 crab fishing seasons.









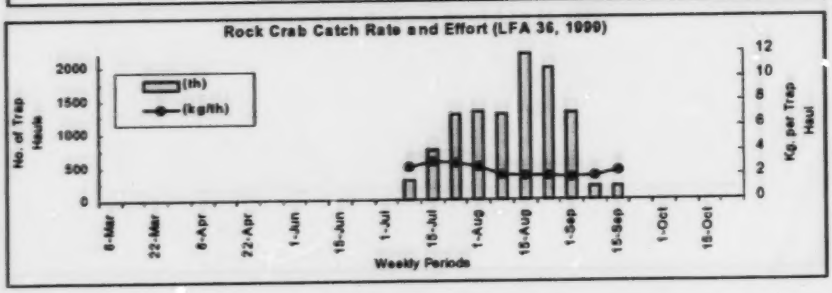


Figure 13. Lobster bycatch (based on logbook information) in number of lobsters per trap haul, by monthly period for LFA's 34, 35 & 36 from 1995 to 1999.